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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
08/992,767	12/17/1997	HIROAKI YOKOYAMA	NEC-19654	4197

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EXAMINER	
WILLE, DOUGLAS A	

ART UNIT	PAPER NUMBER
2814	

DATE MAILED: 06/06/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	08/992,767	YOKOYAMA, HIROAKI	
	Examiner	Art Unit	
	Douglas A Wille	2814	

- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 April 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *11,13-15,17-20,22-24,26-29,31-33,35-38,40-42 and 44-46* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *11,13-15,17-20,22-24,26-29,31-33,35-38,40-42,44-46* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 11, 13 – 15, 17 – 20, 22 – 24, 26 – 29, 31 – 33, 35 – 38, 40 – 42 and 44 – 46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kuwajima in view of Roberts et al., McDavid, Miller et al. and Kim et al.

3. With respect to claims 11, 13, 17, 22, 26, 29, 31, 35, 40 and 44, Kuwajima shows that for semiconductor devices it is necessary to form different sized vias for contacts (see cover Figure and column 3, line 13 et seq.) and show that to meet requirements for material removal related to the nonuniformity of the surface, the film thickness is selected to provide complete filling of the small via and covering the sidewalls of the large via. Kuwajima also shows that the plug is a refractory material, W or Mo (column 9, line 11). Roberts et al. show the formation of metallized vias (see cover Figure and column 4, line 37 et seq.) where an upper metal layer is redeposited to form both a fluted upper area and a corner filling lower area where the corner filling is much less than half the thickness of the insulation layer. This technique provides improved step coverage (see abstract). The Roberts et al. technique depends upon having an upper metal layer which is redistributed into the corners of the via and is directed toward vias with a 2:1 aspect ratio (column 5, line 40). McDavid shows a technique of forming a metallization in a via (see cover Figure and column 2, line 18 et seq.) where the corner filling 13 is formed by anisotropically

etching a preliminary metal layer. It would have been obvious to modify the Roberts et al. technique to form the corner filling using the McDavid method so that it is not necessary to maintain an upper metal layer and to apply this technique to Kuwajima to improve step coverage. Note that without the requirement to deal with the radius of the film, it is not necessary that the remaining portion of the fill in the large via reach to the top. Kim et al. show a method of forming metallization in a via (see cover Figure and column 4, line 8 et seq.) where the upper surface of the via is wider, which effectively reduces the aspect ratio (column 1, line 62). Note that Roberts et al. also show the fluted upper area of the via. It would have been obvious to specifically include this feature to reduce the aspect ratio and thus improve coverage. While Kuwajima does not specify the aspect ratio of the vias it would be expected that, in practice, it would be desirable to form vias without concern for the aspect ratio. Miller et al. show the formation of a metallized via (see cover Figure and column 5, line 22) for high aspect ratio holes (column 2, line 43). It would have been obvious to use the use the method shown above for the low aspect ratio holes and to use the Miller et al. technique for the high aspect ratio holes and to use the fluted upper area of the hole as shown by Kim et al. for all the holes. Note that Kuwajima shows that the barrier layers 13 a, b (Figure 3) and 13 (Figure 10) are part of the plug and can be allowed to remain at the bottom of the large via or not. For a plug material which does not require a barrier it would be obvious to omit the barrier.

4. With respect to claims 14, 15, 18,19, 23, 24, 27, 28, 32, 33, 36, 37, 41, 42, 45 and 46, Roberts et al. show that the corner filling is a small fraction of the thickness of the insulation layer and could obviously accommodate any particular ratio that is desired.

5. With respect to claims 20 and 38, see the above rejection and note that in the formation of both large and small aspect ratio vias, it would be obvious to cease deposition of the refractory material when the high aspect ratio hole is filled to avoid producing a hump in the deposition and this would leave the small aspect ratio via with a refractory liner that is half the diameter of the other via. Note that upon formation of the lining for the low aspect ratio via, the anisotropic etch would leave the width of the metallization unchanged at the bottom of the via.

Response to Arguments

1. Applicant's arguments filed 7/8/02 have been fully considered but they are not persuasive.

2. Applicant states that the references do not show a plug that reaches the substrate which is apparently a reference to the barrier material being between the plug and the substrate. Note that it is known in the art to use a barrier with materials such as W but that with materials that do not need a barrier it would be obvious to omit it, as noted above. Applicant argues that layer 2 is not the substrate in Kuwajima but since it is a doped region in the substrate, it is part of the substrate

3. Applicant states that the other references fail to show large and small contact holes but this is piecemeal analysis and the combination of all the references shows the claimed device. Note that Kuwajima shows both large and small contact holes.

Conclusion

4. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Douglas A Wille whose telephone number is (703) 308-4949. The examiner can normally be reached on M-F (6:15-2:45).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmi can be reached on (703) 308-4918. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Douglas A. Wille
Primary Examiner

June 4, 2003